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ABSTRACT

A water flow control system has a pressure reduction valve (15) in a cold water line (12) between the water source (10) and a cold water tap (18, 18a). A hot water line (14) connects the hot water tap (19, 19a) to a water heater (13). When the hot water tap (19, 19a) is turned on, a control valve (24, 24a) directs any cold/cool water in the hot water line (14) via a bypass line (26, 26a) to the cold water line (12). As the cool/cold water from the hot water line (14) is at a higher pressure than the cold water in the cold water line (12), cold water from the cold water line (12) is displaced into a pressurised bladder (21) in a pressurised tank (20). When the water in the hot water line (14) reaches a preset temperature, the control valve (24, 24a) directs the hot water to the hot water tap (19) or a hot water outlet. When the cold tap (18, 18a) is turned on, the air pressure in the pressurised tank (20) displaces the water in the bladder (21) back into the cold water line.

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Regulation 3.2

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Patents Act 1990

ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title: "WATER FLOW CONTROL SYSTEM"

The following statement is a full description of this invention, including the best method of performing it known to me:

THIS INVENTION relates to a water flow control system.

The invention is particularly suitable for, but not limited to, a flow control system which minimises the use of water.

The supply of clean, safe water is a major problem for authorities around the world. As populations grow, and the demand for water increases, authorities are looking at many different ways for reducing water demand. For example, the citywide introduction of water meters within the area administered by Brisbane City Council reduced water consumption by approximately 30% and deferred the need for a multi-million dollar water treatment plant.

Even a very small saving can prove significant, eg., fixing a dripping tap or a leaking toilet system.

One area which has not been given attention is the water wasted when a hot water tap is turned on and is allowed to run until at least warm water is received at the tap. When a hot water tap is turned on frequently, hot water will be received almost instantaneously at the tap. However, when the tap has not been turned on for some time (eg., overnight), and particularly when the tap is some distance, eg., 5 metres plus, from the water heater, the tap may need to be turned on for several seconds before hot water is received.

It has been calculated that a one metre length of 13mm diameter copper pipe contains approximately 85ml of water. This means, for example, that where the hot water tap is 10m from the water heater, which is not unusual in many homes, approximately 850ml of water, which has cooled in the hot water pipe, is likely to be discharged before

hot water reaches the hot water tap. In most cases, this water is simply allowed to flow to waste.

It is an object of the present invention to provide a water flow control system which enables cool, or cold, water in a hot water line to be recovered for later use.

It is a preferred object of the present invention to provide such a system where the cool, or cold, water is temporarily stored for supply to cold water taps.

It is a further preferred object of the present invention to provide a kit of parts suitable for installation in an existing water supply system or as part of the new water supply installation.

Other preferred objects of the present invention will become apparent from the following description.

In one aspect, the present invention resides in a method of controlling water flow in a water system of the type having at least one cold water tap, at least one hot water tap and a water heating means connected to a water source, including the steps of:

providing a pressure reducing means in a cold water line between the cold water tap and the source;

providing a pressurise**d**[*able*] tank in the cold water line downstream of the pressure reducing means; and

providing a controllable valve, operable to connect a hot water line from the water heating means to the hot water tap or to a bypass line connected to the cold water line ([*or*] **and/or the pressurised** tank), so arranged that:

on initial opening of the hot water tap, the controllable valve

initially connects the hot water line to the bypass line to direct cold, or cool, water in the hot water line to the cold water line ([*or*] **and/or the pressurised** tank), and then connects the hot water line to the hot water tap to direct hot, or at least warm, water from the water heating means to the hot water tap.

In a second aspect, the present invention resides in a method of controlling water flow in a water system of the type having at least one cold water tap, at least one hot water tap and a water heating means connected to a water source, including the steps of:

providing a pressure reducing means in a cold water line between the cold water tap and the source;

providing a pressurised[*able*] tank in the cold water line downstream of the pressure reducing means; and

providing a controllable valve, operable to connect the hot water line from the water heating means, downstream of the hot water tap, to a hot water outlet or to a bypass line connected to the cold water line ([*or*] **and/or the pressurised** tank); so arranged that:

on initial opening of the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cold, or cool, water in the hot water line to the cold water line ([*or*] **and/or the pressurised** tank) and then connects the hot water line to the hot water outlet to direct hot, or at least warm, water from the water heating means to the hot water outlet.

In a third aspect, the present invention resides in a water flow control system for a water supply having at least one cold water tap, at least one hot water tap, and a water heating means connected to a water supply including:

a pressure reduction means in a cold water line connecting the cold water tap to the water supply;

a pressurised[*able*] tank connected to the cold water line downstream of the pressure reduction means; and

a controllable valve in a hot water line, downstream from the water heating means, to operably connect the hot water line to the hot water tap or to a bypass line connected to the cold water line (**and/or** to the **pressurised** tank); so arranged that:

on initially opening the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cool, or cold, water therein to the cold water line (and/or the **pressurised** tank) and then connects the hot water tap to the hot water line to direct hot, or at least warm, water from the water heating means to the hot water tap.

In a fourth aspect, the present invention resides in a water flow control system for a water supply having at least one cold water tap, at least one hot water tap, and a water heating means connected to a water supply including:

a pressure reduction means in a cold water line connecting the cold water tap to the water supply;

a pressurised[*able*] tank connected to the cold water line downstream of the pressure reduction means; and

a controllable valve in a hot water line, downstream of the hot water tap, to operably connect the hot water line to a hot water outlet or to a bypass line connected to the cold water line (**and/or** to the **pressurised** tank); so arranged that:

on initially opening the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cool, or cold, water therein to the cold water line ([*or*] **and/or the pressurised** tank) and then connects the hot water line to the hot water outlet to direct hot, or at least warm, water from the water heating means to the hot water outlet.

Preferably, the pressure reduction means is a pressure reduction valve, which may be selectively adjustable.

The bypass line can be connected directly to the cold water line or the **pressurised** tank [*means*], or to a fitting (eg., a T-fitting) just upstream of the cold water tap (eg., in a combination set); or to a fitting on the cold water side of a mixer tap.

The controllable valve means may be manually operable, or automatically operable, eg., by a spring means after a preset time, eg., 3-10 seconds. The controllable valve means may be operable by an actuator, which may be controlled by a control unit with a timer and/or with a heat sensor (eg., a bi-metallic spring, thyristor or thermacouple) operable to measure the temperature of the water flowing in the hot water line.

The **pressurised** tank [*means*] is preferably pressurised[*able*] to a selected pressure level, eg., by air. In one preferred embodiment, the cold water enters an expandable bladder which is surrounded by pressurised air in the **pressurised** tank.

Preferably, the pressure in the **pressurised** tank is set at a pressure intermediate the water pressure from the source and the water pressure downstream of the pressure reducing means.

The pressurised tank may be connected to the cold water line intermediate a pair of the cold water taps.

In a **fifth** [*third*] aspect, the present invention resides in a kit of parts suitable for carrying out the method.

To enable the invention to be fully understood, preferred embodiments will now be described with reference to the accompanying drawings in which:

FIG. 1 shows a schematic layout of a first embodiment of an installation suitable for a house;

FIG. 2 is a schematic layout of a portion of a second embodiment of a retro-fit kit;

FIG. 3 is a schematic plan view of a manually-operable valve for a third embodiment; and

FIGS. 4 to 6 show the valve of FIG. 3 in its three alternative positions.

Referring to FIG. 1, water from a supply 10 is typically supplied in the pressure range of 280 to 700 kPa (40-100 p.s.i.) from a reticulated mains supply or from a pressure pump (connected to a tank).

At a junction 11, the water is either directed to a cold water line 12 or to the inlet of a water heater 13. The water heater may be of electric, gas, solar, or any suitable type and its outlet is connected to a hot water line 14.

A pressure reducing valve 15 is provided in the cold water line 12 and on its downstream side, reduces the water pressure to eg., 140 kPa (20 p.s.i.).

A pair of installations, eg., a bathroom shower 16 and a kitchen sink 17 are each provided with a water combination having a cold water tap 18, 18a, respectively, and a hot water tap 19, 19a, respectively.

The cold water taps 18, 18a are connected to the cold water line 12, while the hot water taps 19, 19a are connected to the hot water line 14 by the methods to be hereinafter described.

The tank 20 has an inflatable bladder 21 surrounded by air 22 within a metal body 23. A nipple (not shown) at the base of the tank allows pressurised air to be pumped into the tank body 23 to surround the bladder 21.

In the embodiment to be hereinafter described, the tank 20 will be pressurised so that the air pressure within the tank is in the range of 210 to 245 kPa (30 to 35 p.s.i.), ie., so that the air pressure is between the pressure of the water from the supply 10 and the pressure in the cold water pipe downstream of the pressure reducing valve 15.

A thermally-operated control valve 24 is interposed between the hot water tap 19 and the hot water line 14 and the control valve 24 has an outlet 25 connected via a cold water bypass line 26, fitted with a diaphragm-operated stop valve 27 (or piston-type valve). A stop valve closing pipe 28 connects the stop valve 27 to the hot water line 14a downstream of the control valve 24.

In the alternative arrangement for hot tap 19a, the control valve 24a is provided downstream of the hot water tap 19a and has its outlet 25a connected to the cold water line 12a by the cold water bypass line 26a.

The operation of the system will now be described.

Air 22 in the tank 20 is pressurised to, eg., 210 kPa.

When the hot water tap 19 is initially turned on, a temperature-sensitive actuator in the control valve 24, causes the control valve 24 to direct any cold, or cool, water in the hot water line 14 to flow into the bypass line 26. As this water is at substantially the pressure of the water from the supply 10, it flows through the cold water line 12 towards the tank 20. An equivalent volume of cold water in the cold water line is displaced into the bladder 21, and the bladder 21 expands against the pressure of the air 22 in the tank. When the water in the hot water line has reached a preset level, eg., 60-80°C, as sensed by a temperature sensor in the control valve 24, the actuator moves the control valve 24 to connect the hot water line 14 to the hot water tap 19 so that hot, or at least, warm, water is supplied to the shower outlet 16. The flow of hot water through hot water line 14a will also direct hot water through valve closing pipe 28 to operate the diaphragm stop valve 27 and isolate the control valve 24 from the cold water line 12. (The stop valve 27 is normally biassed to connect the control valve 24 to the cold water line 12.)

Referring to control valve 24a, when tap 19a is initially turned on, cold (or cool) water through the hot water tap 19a will cause the temperature sensor in the control valve 24a to operate the actuator so that the control valve 24a will direct the water to the cold water line 12 via the bypass line 26a.

When the water temperature in the water passing through

the hot water tap 19a reaches the preset level, eg., 60-80°, the control valve 24a will then direct the (now hot) water to the water outlet, and thereby to the kitchen sink 17.

Where the control unit, or spring timer in the control valve 24a, operates only on a time basis, the time period in which the hot water line 14 is connected to the bypass line 26a, by the control valve 24a, will be determined by the distance that the hot water tap 19a is from the water heater 13.

When either of the cold water taps 18, 18a are turned on, the pressure of the air 22 in the tank 20 will cause the bladder 21 to at least partially deflate, and force the water in the bladder 21 into the cold water line 12 before water flows from the source 10 through the pressure-reducing valve 15 into the cold water line 12.

Assuming that the hot water tap 19 is 10 metres from the water heater 13, and so, eg., 850ml of water will be contained in the hot water line 14 therebetween, it is preferred that the water capacity of the bladder 21 in the tank 20 will be 3-5 times the volume of water in the cold water line 14 (ie., 2.5-4.5 litres).

It will be readily apparent to the skilled addressee that the system may be used with one or more pairs of cold and hot water taps and/or mixer combinations and that the water bypass from one hot water tap may be bled to one or more of the other cold water taps.

The pressure reduction by the pressure reduction valve 15, the pressure of the air 22 in the tank 20; the preset period(s) for which the control valve 24, 24a are open, and the water temperature range

monitored by the sensor in the control valves 24, 24a, can all be varied to suit the particular intended installation.

Referring to FIG. 2, a retro-fit kit 100 can be provided with a thermally-controlled valve 124 and a piston-operated stop valve 127. (The piston-operated stop valve may be replaced by a diaphragm, flapper or other suitable pressure-sensitive valve.)

When the hot water tap 119 is closed, the pressure (eg., 315 kPa/45psi) in the hot water line 114 on piston 150 causes the valve jumper 151 in the stop valve 127 to engage its seat 152.

When the hot water tap 119 is initially opened, the control valve 124 will direct the cool (or cold) water to the bypass line 126, and the reduced pressure in the valve closing pipe 128 relative to the pressure in the cold water bypass line 126, causes the piston 150 to unseat the valve jumper 151 to allow the cool (or cold) water in the hot water line 114 to be directed to the cold water line 112 (which may be at a pressure of 210 kPa/30psi).

When the preset temperature is reached in the hot water line 114, the control valve will direct the hot water to the hot water tap 119. The pressure in valve closing line 128 will cause the stop valve 127 to re-close.

Referring now to FIGS. 3 to 6, the thermally-operated control valve 24, 24a, 124 can be replaced by a manually operable control valve 224 which has three positions A, B, C, wherein:

a) in position A, the water heater 213 is isolated from both the hot water tap 219 and bypass line 226; and

b) in position B, the water heater 213 (and hot water line 214) is connected to the bypass line 226 to direct the cool/cold water to the cold water line (or tank); and

c) in position C, the water heater 213 is connected to the hot water tap 219.

An adjustable alarm or timer, eg., a bell, can be positioned adjacent the valve 224 and be started when the hot water tap 219 is turned on and the valve 224 moved from position A to position B. When the alarm/timer indicates the preset time has elapsed, the valve 224 is moved to position C.

Various changes and modifications may be made to the embodiments described and illustrated without departing from the present invention.

The claims defining the invention are as follows:

1. A method of controlling water flow in a water system of the type having at least one cold water tap, at least one hot water tap and a water heating means connected to a water source, including the steps of:

providing a pressure reducing means in a cold water line between the cold water tap and the source;

providing a pressurised[*able*] tank in the cold water line downstream of the pressure reducing means; and

providing a controllable valve, operable to connect a hot water line from the water heating means to the hot water tap or to a bypass line connected to the cold water line ([*or*] **and/or the pressurised** tank), so arranged that:

on initial opening of the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cold, or cool, water in the hot water line to the cold water line ([*or*] **and/or the pressurised** tank), and then connects the hot water line to the hot water tap to direct hot, or at least warm, water from the water heating means to the hot water tap.

2. A method of controlling water flow in a water system of the type having at least one cold water tap, at least one hot water tap and a water heating means connected to a water source, including the steps of:

providing a pressure reducing means in a cold water line between the cold water tap and the source;

providing a pressurised[*able*] tank in the cold water line downstream of the pressure reducing means; and

providing a controllable valve, operable to connect the hot water line from the water heating means, downstream of the hot water

tap, to a hot water outlet or to a bypass line connected to the cold water line ([*or*] **and/or the pressurised** tank); so arranged that:

on initial opening of the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cold, or cool, water in the hot water line to the cold water line ([*or*] **and/or the pressurised** tank) and then connects the hot water line to the hot water outlet to direct hot, or at least warm, water from the water heating means to the hot water outlet.

3. A water flow control system for a water supply having at least one cold water tap, at least one hot water tap, and a water heating means connected to a water supply including:

a pressure reduction means in a cold water line connecting the cold water tap to the water supply;

a pressurised[*able*] tank connected to the cold water line downstream of the pressure reduction means; and

a controllable valve in a hot water line, downstream from the water heating means, to operably connect the hot water line to the hot water tap or to a bypass line connected to the cold water line ([*or*] **and/or the pressurised** tank); so arranged that:

on initially opening the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cool, or cold, water therein to the cold water line ([*or*] **and/or to the pressurised** tank) and then connects the hot water tap to the hot water line to direct hot, or at least warm, water from the water heating means to the hot water tap.

4. A water flow control system for a water supply having at least one cold water tap, at least one hot water tap, and a water heating

means connected to a water supply including:

a pressure reduction means in a cold water line connecting the cold water tap to the water supply;

a pressurised[*able*] tank connected to the cold water line downstream of the pressure reduction means; and

a controllable valve in a hot water line, downstream of the hot water tap, to operably connect the hot water line to a hot water outlet or to a bypass line connected to the cold water line ([*or*] **and/or to the pressurised** tank); so arranged that:

on initially opening the hot water tap, the controllable valve initially connects the hot water line to the bypass line to direct cool, or cold, water therein to the cold water line (or to the tank) and then connects the hot water line to the hot water outlet to direct hot, or at least warm, water from the water heating means to the hot water outlet.

5. A system as claimed in Claim 3 or Claim 4 wherein:

the pressure reduction means is a pressure reduction valve, which is optionally selectively adjustable.

6. A system as claimed in any one of Claims 3 to 5 wherein:

the bypass line is connected directly to the cold water line, or the tank means, or to a fitting just upstream of the cold water tap or to a fitting on the cold water side of a mixer tap.

7. A system as claimed in any one of Claims 3 to 6 wherein:

the controllable valve means is manually operable, or automatically operable by a spring means after a preset time.

8. A system as claimed in any one of Claims 3 to 6 wherein:

the controllable valve means is operable by an actuator, which is controlled by a control unit with a timer and/or with a heat sensor (optionally a bi-metallic spring, thyristor or thermacouple) operable to measure the temperature of the water flowing in the hot water line.

9. A system as claimed in any one of Claims 3 to 8 wherein:

the **pressurised** tank [*means*] is pressurised[*able*] to a selected pressure level by air.

10. A system as claimed in Claim 9 wherein:

the cold water enters an expandable bladder which is surrounded by pressurised air in the **pressurised** tank.

11. A system as claimed in any one of Claims 3 to 10 wherein:

the pressure in the **pressurised** tank is set at a pressure intermediate the water pressure from the source and the water pressure downstream of the pressure reducing means.

12. A system as claimed in any one of Claims 3 to 11 wherein:

The **pressurised** tank is connected to the cold water line intermediate a pair of the cold water taps.

13. A method of controlling water flow in a water system, substantially as hereinbefore described with reference to FIG. 1, or FIG. 1 as modified by FIG. 2; or FIG. 1 as modified by FIGS. 3 to 6, of the accompanying drawings.

14. A water flow control system substantially as hereinbefore described with reference to FIG. 1, or FIG. 1 as modified by FIG. 2; or FIG. 1 as modified by FIGS. 3 to 6, of the accompanying drawings.

15. A kit of parts for effecting the method of any one of Claims

1, 2 or 13.

16. A kit of parts for the water flow control system of any one of Claims 3 to 12 and 14.

DATED this eighth day of March 2001.

LLOYD LINSON SMITH

By his Patent Attorneys

FISHER ADAMS KELLY

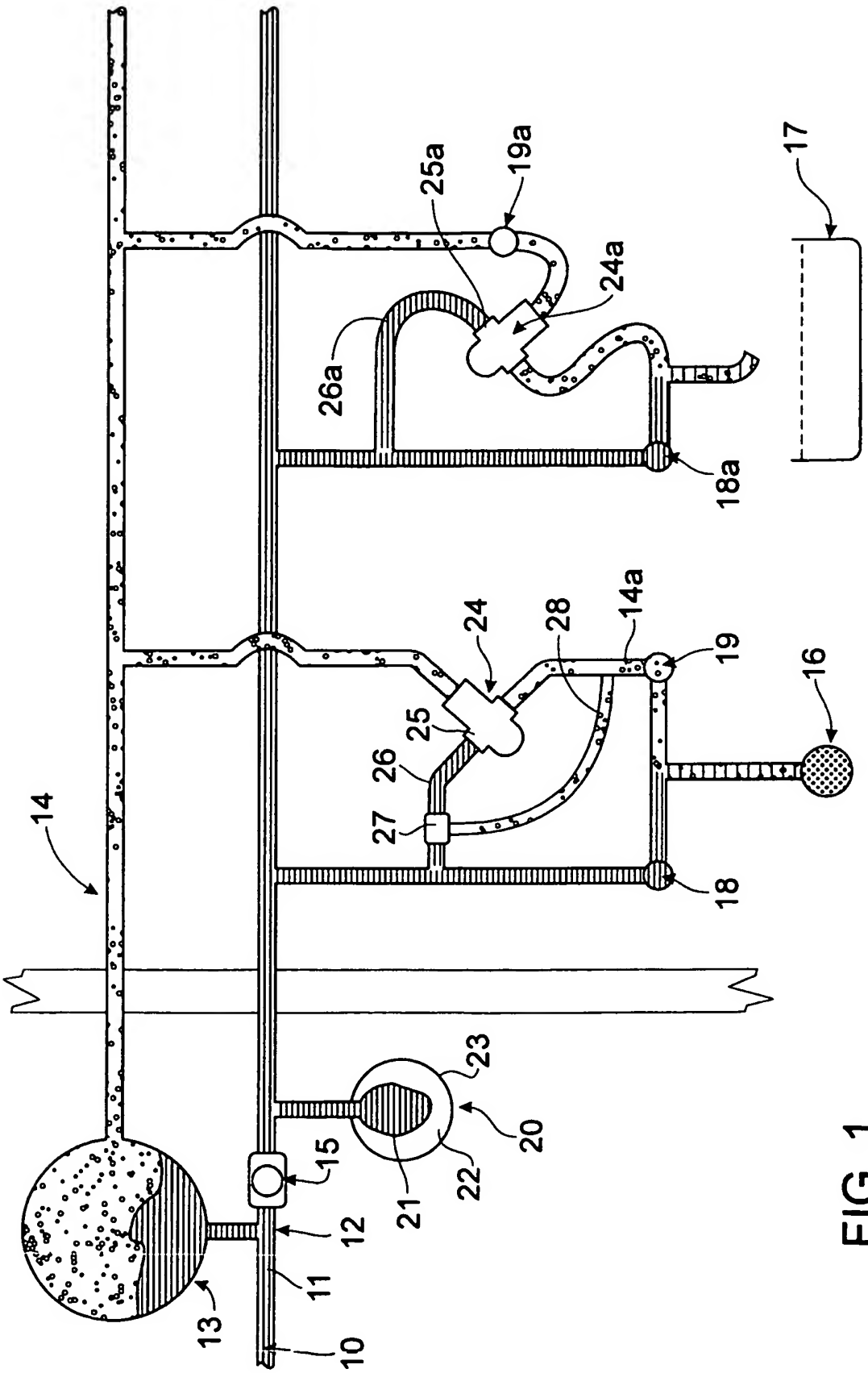
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FIG. 1

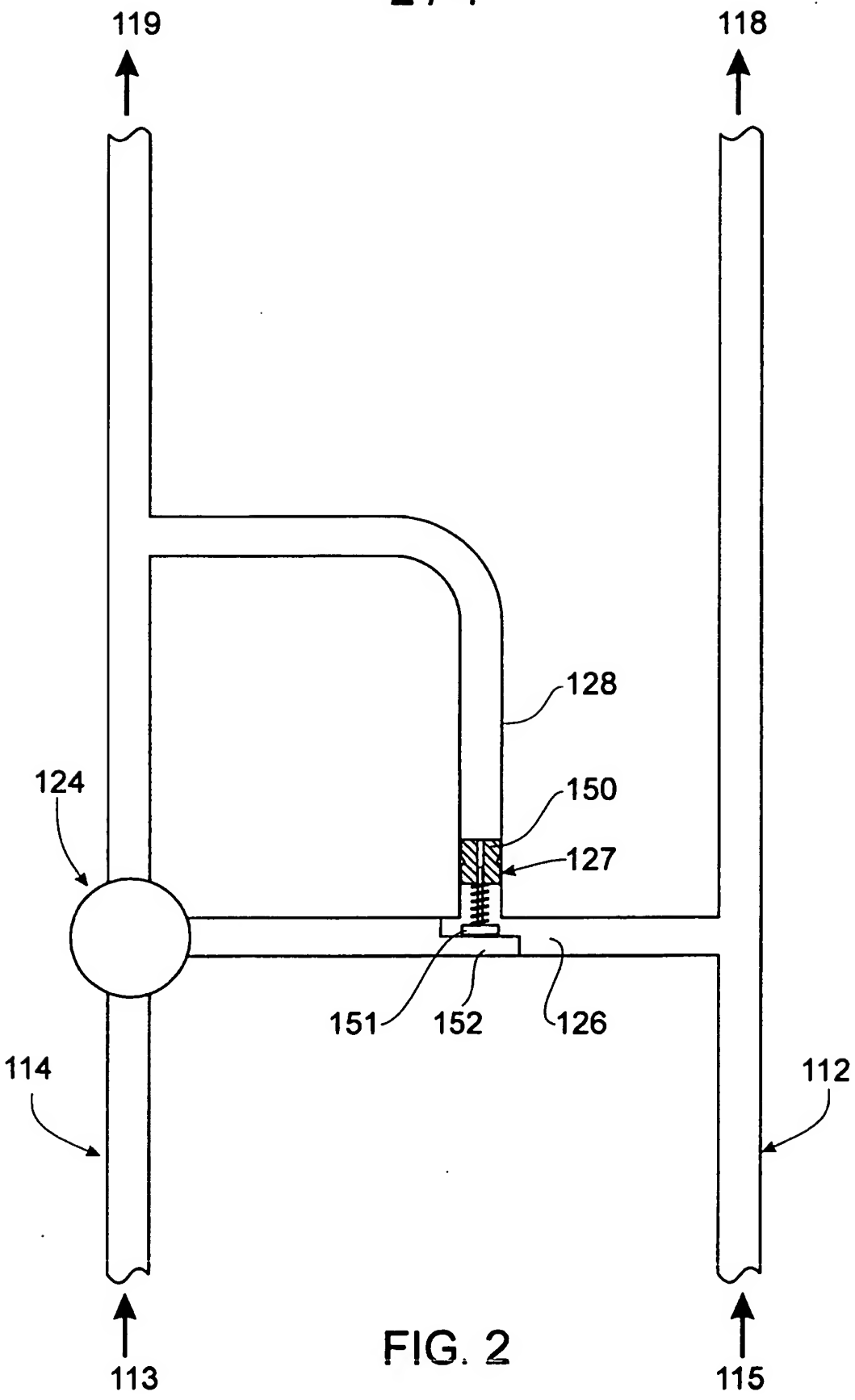

FIG. 2

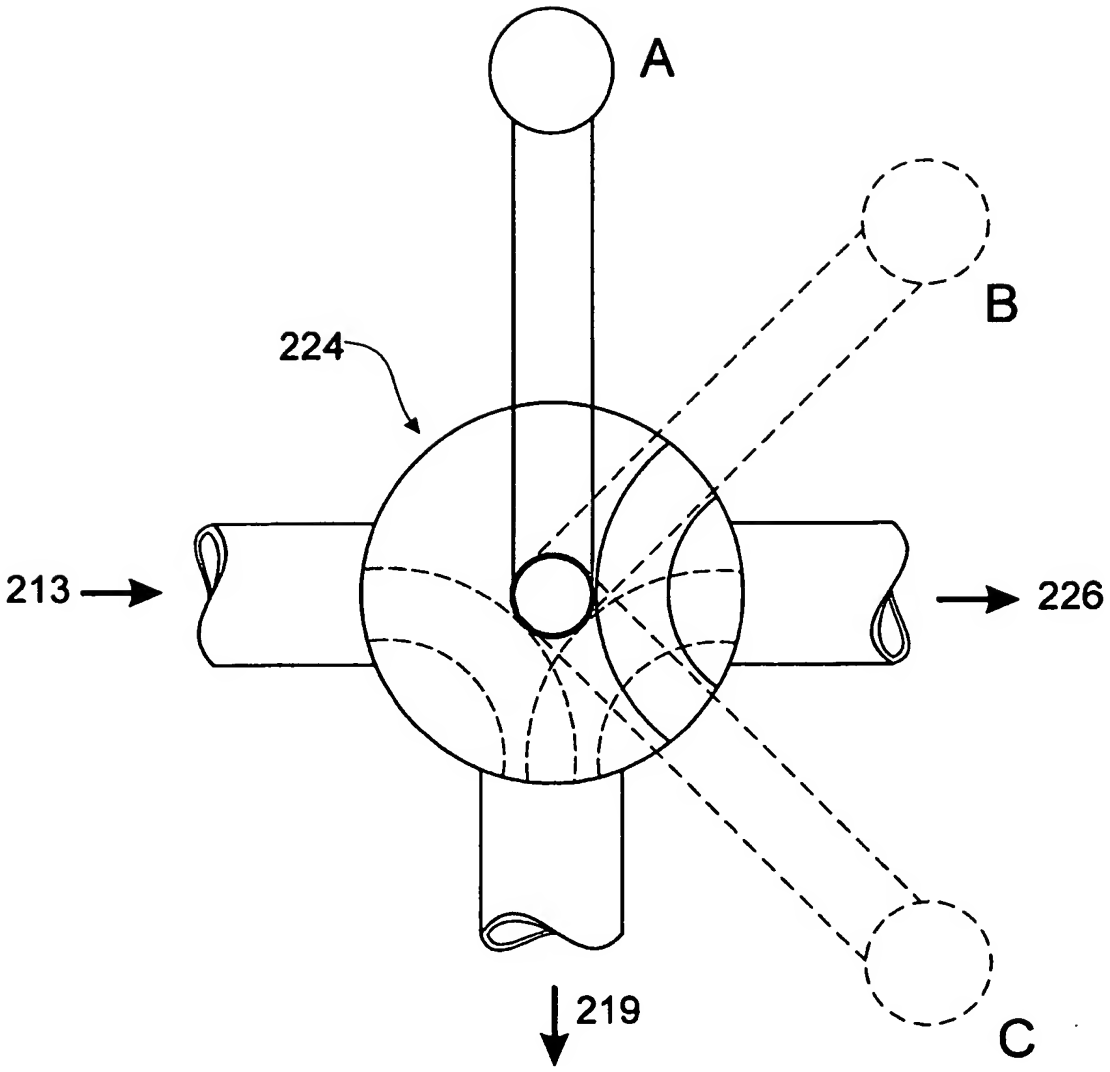

FIG. 3

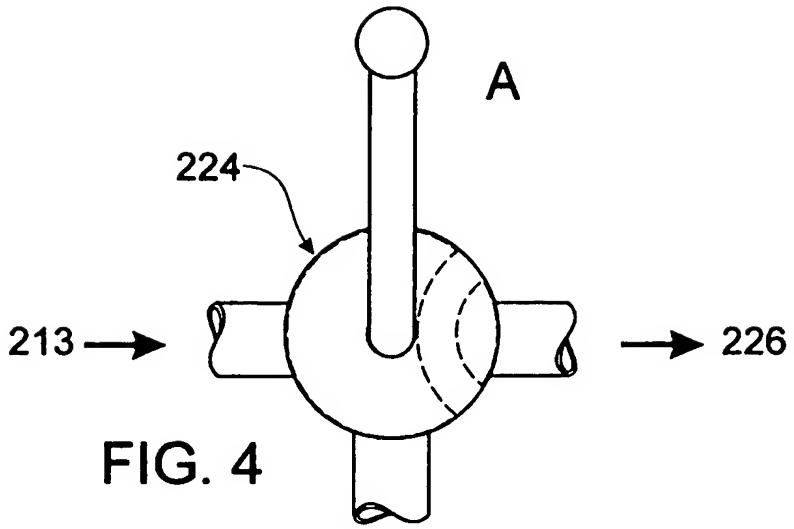

FIG. 4

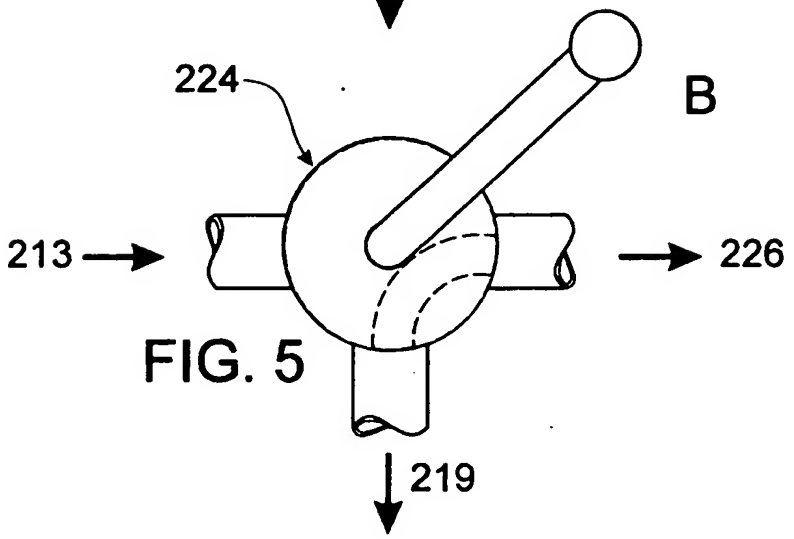

FIG. 5

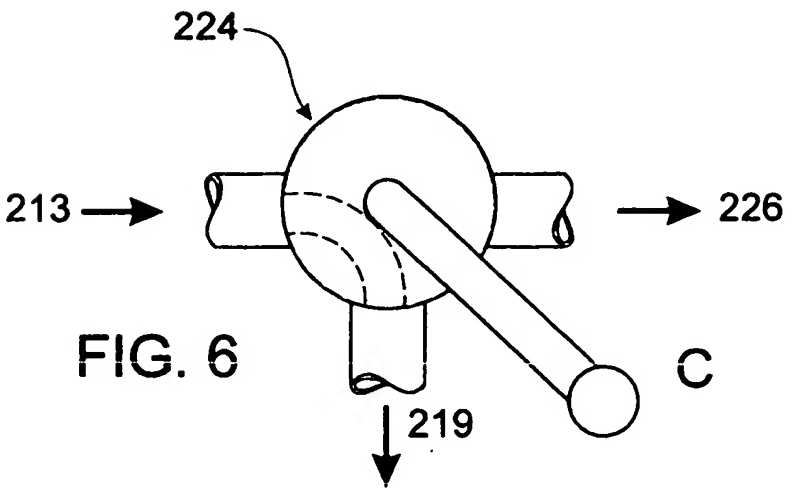

FIG. 6